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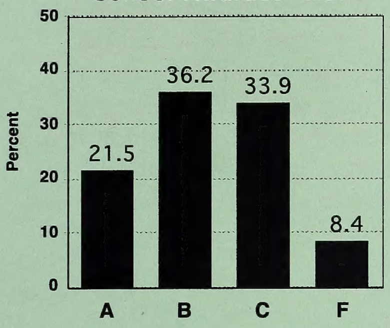
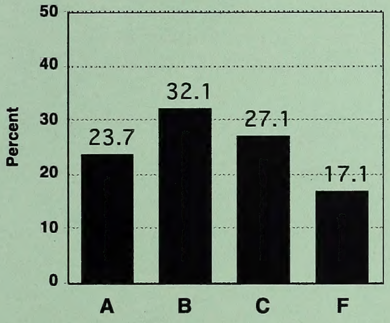
Biology 30

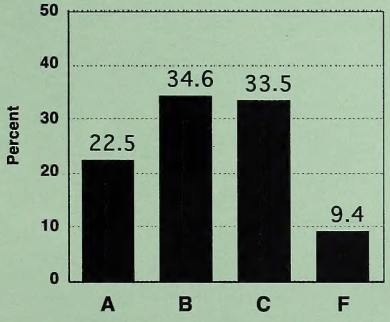
Diploma Examination Results
Examiners' Report for January 1994

CANADIANA

AUG 9 1995


School-Awarded Mark


Diploma Examination Mark


Final Course Mark

The summary information in this report provides teachers, school administrators, students, and the general public with an overview of results from the January 1994 administration of the Biology 30 Diploma Examination. This information is most helpful when used with the detailed school and jurisdiction reports that have been mailed to schools and school jurisdiction offices. An annual provincial report containing a detailed analysis of the combined January, June, and August results is published each year.

Description of the Examination

The Biology 30 Diploma Examination consists of two parts: a multiple-choice section of 70 questions worth 70% and a written-response section of four questions worth 30% of the total examination mark.

Achievement of Standards

The information reported is based on the final course marks achieved by 8 539 students in Alberta who wrote the January 1994 examination. This represents a decrease of 1380 students compared to January 1993. The decrease is partially accounted for by the fact that 919 students received final course marks in the revised (pilot) Biology 30 course. Since these pilot students did not write the January 1994 diploma examination, the information in this report does not include them.

- 90.6% of the 8 539 students achieved the acceptable standard (a final course mark of 50% or higher).
- 22.5% of the 8 539 students achieved the standard of excellence (a final course mark of 80% or higher).

Generally, student achievement in Biology 30 was good. Compared to January 1993, there was an increase (89.6 to 90.6) in the percentage of students, who achieved the acceptable standard. Most students demonstrated a good understanding of cellular processes, the function of human organ systems and the processes of science. Many students demonstrated the ability to make meaningful connections between concepts of human physiology and technology.

Approximately 58.1% of the students who wrote the examination were female. Approximately 81.0% of this female population achieved the acceptable standard on the examination, compared to 85.6% of the male population.

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Student Evaluation

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Provincial Averages

- The average school-awarded mark was 67.2%.
- The average diploma examination mark was 66.1%.
- The average final course mark, representing an equal weighting of the school-awarded mark and the diploma examination mark, was 67.2%.

Approximately 16.2% of the students who wrote the examination in January 1994 and received a school-awarded mark had written at least one other Biology 30 Diploma Examination during the June 1992 to August 1993 period. This subpopulation (1 382) achieved an examination average of 63.1%, compared to 66.7% for the population (7 157) whose first writing of a Biology 30 examination was in January 1994. However, the group of students who rewrote (1 382) increased their examination average score from 50.2% to 63.1%.

Results and Examiners' Comments

Subtest: Machine Scored

When analyzing detailed examination results, please bear in mind that subtest results **cannot** be directly compared.

Results are in average raw scores.

Machine Scored: 47.9 out of 70

Course Content

- Cellular Processes: 5.5 out of 8
- Homeostatic Mechanisms: 2.2 out of 3
- Nutrition and Digestion: 6.7 out of 10
- Body Fluids: 6.7 out of 10
- Breathing, Gas Exchange, and Transport: 2.8 out of 4
- Energy Release: 1.3 out of 2
- The Kidney: 3.2 out of 5
- Regulation of the Internal Environment: 9.9 out of 14
- Voluntary Movement and Body Support: 2.6 out of 4
- Human Reproduction: 7.1 out of 10

Process Skills: 9.4 out of 14

- Multiple-choice questions 6, 7, 15, 17, 26, 37, 54, 55, 56, 58, 59, 64, 67, and 68.

Cognitive Levels

- Knowledge: 16.7 out of 25
- Comprehension and Application: 25.6 out of 36
- Higher Mental Activities: 5.6 out of 9

Machine-Scored Blueprint (Multiple Choice)

Each question in this section is classified in two ways: according to the curricular content area being tested and according to the cognitive level demanded by the question. The examination blueprint illustrates the distribution of questions in January 1994 according to these classifications.

Course Content	Machine Scored			Examination Emphasis (%)
	Knowledge	**Comprehension and Application**	**Higher Mental Activities**	
Cellular Processes	1, 4	2, 3, 5, 8	6, 7	8
Homeostatic Mechanisms	9	10, 11		3
Nutrition and Digestion	12, 13, 14, 21	16, 17, 18, 19, 20	15	10
Body Fluids	22, 23, 24, 25	26, 27, 28, 29, 30, 31		10
Breathing, Gas Exchange, and Transport	32, 33	34, 35		4
Energy Release	36	37		2
The Kidney	38, 39, 41	40, 42		5
Regulation of the Internal Environment	43, 44, 45, 47, 48	46, 49, 50, 51, 52, 53, 54	55, 56	14
Voluntary Movement and Body Support	57	59, 60	58	4
Human Reproduction	61, 62	63, 64, 65, 66, 68	67, 69, 70	10
Examination Emphasis□(%)	25	36	9	70

Subtest: Teacher Scored

Results are in average raw scores.

Teacher Scored: 18.2 out of 30

Written-Response Questions

- Question 1: 5.8 out of 10
- Question 2: 7.2 out of 10
- Question 3: 2.7 out of 5
- Question 4: 2.5 out of 5

Teacher-Scored Blueprint (Written Response)

Each question in this section is designed to measure student achievement of two or more course objectives. Furthermore, students are expected to use a variety of cognitive skills to construct satisfactory responses. The examination blueprint illustrates the distribution of questions in January 1994 according to these classifications.

Question Number	Teacher Scored Question Description (Concept, Cognitive Levels, and Process Skills)	Mark Value
1	Explaining symptoms of cystic fibrosis. Forming hypotheses about possible treatments and related technologies. Communicating clearly and logically.	10
2	Identifying variables, forming hypotheses, forming and evaluating conclusions.	10
3	Identifying and explaining causes of hypertension. Evaluating new ideas derived from novel technologies.	5
4	Identifying and explaining processes that occur within the nephron.	5
	Total	30

Multiple Choice

Question	Key	Difficulty*	Question	Key	Difficulty*
1	A	76.8	36	A	69.9
2	D	76.8	37	A	55.4
3	A	67.6	38	B	54.7
4	D	66.6	39	C	65.2
5	A	66.2	40	D	67.8
6	D	49.8	41	C	76.3
7	D	60.7	42	C	53.6
8	B	89.2	43	D	70.5
9	C	68.0	44	B	38.5
10	D	71.6	45	D	73.3
11	B	75.0	46	B	83.8
12	C	79.9	47	B	78.7
13	B	53.4	48	A	73.7
14	B	63.7	49	B	72.9
15	A	56.0	50	D	76.2
16	A	80.2	51	C	82.5
17	B	75.3	52	D	79.3
18	D	66.1	53	D	56.5
19	B	68.5	54	C	72.6
20	A	65.5	55	D	66.8
21	D	64.1	56	A	65.0
22	D	52.5	57	B	73.0
23	A	86.2	58	B	77.9
24	A	53.9	59	B	62.1
25	D	54.5	60	C	48.5
26	C	82.2	61	D	79.8
27	D	68.4	62	A	69.2
28	B	71.8	63	A	66.4
29	A	67.7	64	A	80.8
30	B	74.6	65	C	87.9
31	B	56.9	66	D	75.8
32	A	64.4	67	C	67.6
33	C	60.7	68	A	63.4
34	A	70.8	69	B	64.3
35	D	83.8	70	D	49.8

*Difficulty—percentage of students answering the question correctly

This examination has a balance of question types and difficulties. It is designed so that students capable of achieving the acceptable standard will obtain a mark of 50% or higher and students capable of achieving the standard of excellence will obtain a mark of 80% or higher. This examination is parallel in structure to the 1993 Biology 30 examinations. The maximum value of any one written-response question is 10 marks. The four questions require students to use a variety of thinking skills, all of which go beyond, but are not isolated from, the ability to recall core concepts. Two of the four questions require students to relate technology to an understanding of science concepts.

Machine-Scored Section (Multiple-Choice Questions)

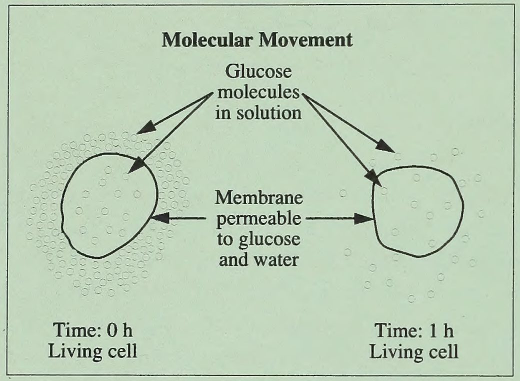
For a complete breakdown of student responses by alternative for the multiple-choice questions, please refer to the school and jurisdiction reports.

Most students who achieved the acceptable standard interpreted experimental data that was presented in simple graphs or tables (questions 26 and 64). They sequentially ordered the major steps of physiological processes (questions 30 and 35) but had difficulty making structural and functional comparisons among body components (questions 42, 53, and 70). They related physiological concepts to common everyday experiences (questions 27,

Percentage of Students Correctly Answering Selected Machine-Scored Questions

	Question Number				
Student Group	**6**	**7**	**15**	**32**	**59**
All students	49.8	60.7	56.0	64.4	62.1
A (80% or higher)	81.2	89.8	73.3	87.2	83.5
C (50% to 64%)	34.1	46.9	48.9	55.9	54.0
F (less than 50%)	23.2	29.8	36.4	33.5	35.3

Use the following diagram to answer questions 6 and 7.


Molecular Movement
Glucose molecules in solution
Membrane permeable to glucose and water
Time: 0 h
Living cell
Time: 1 h
Living cell

6. Which processes can account for the change in the concentration of glucose molecules outside and inside the cell at time = 1 h?

   A. Osmosis into the cell and excretion out of the cell
   B. Diffusion into the cell and excretion out of the cell
   C. Osmosis into the cell and respiration within the cell
   •D. Diffusion into the cell and respiration within the cell

7. What would have happened to the distribution of glucose molecules if this cell had died at time = 0 h and the permeability of the membrane had remained unchanged?

   A. There would have been no movement of glucose molecules into or out of the cell.

   B. There would have been greater movement of glucose molecules out of the cell than into the cell.

   C. Eventually the concentration of glucose molecules would have become greater inside the cell than outside the cell.

   •D. Eventually the concentration of glucose molecules would have become equal inside the cell and outside the cell.

47, and 68). They understood basic functions of human body structures as assessed by many questions, but they did not know the properties of some key biological substances (questions 22, 25, and 44).

Students who achieved the standard of excellence, in addition to fulfilling the expectations identified above, interpreted interrelated sets of data presented in complex tables or graphs (questions 15, 37, and 59), They analyzed multistep human physiological problems (questions 6, 7, 13, and 31). They formed correct inferences from extracurricular data (questions 59, and 70). Most of these students recognized specialized parts of human structures and understood their functions (questions 24, 42, 53, and 70).

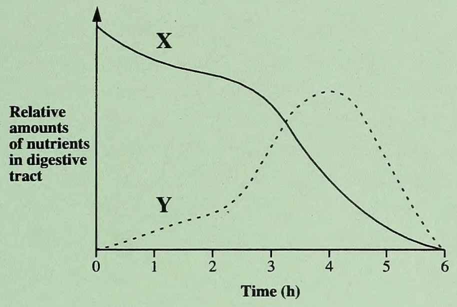
Detailed statistics and comments follow on five questions.

Question 6 required students to analyze the cell model of diffusion and account for the change over time in glucose concentration. They had to distinguish between diffusion and osmosis, excretion and respiration, as well as know the meaning of permeable. The spatial arrangement of the glucose symbols had to be interpreted. About 30% of the students chose osmosis instead of diffusion. Either these students failed to recognize that the cell did not increase in size, or they did not understand that osmosis refers to the movement of water (solvent), not glucose (solute). About 30% chose excretion instead of respiration, not recognizing that this process would increase the concentration of glucose outside the cell, not decrease it. Very few (2.0%) of the high achievers chose both osmosis and excretion (alternative A). The low achievers simply guessed; they chose each of the four alternatives about equally.

Question 7 required students to distinguish between active and passive transport. About 16% of the population, including 5% of the high achievers, chose alternative A. These students assumed that transport of glucose through a cell membrane must be assisted by the action of a living cell. About 9% of the students may have assumed that a dead cell is empty and therefore chose alternative B. About 15% of the students chose alternative C. These students missed the significance of the comparative description given at the end of the statement. About 54% of the female population chose the

Use the following graph to answer question 15.

Differences in Quantities of Nutrients X and Y as They Travel Through the Digestive Tract



15. If nutrients were ingested only at time = 0 h, then line X and line Y could represent, **respectively**,

•**A.** starch and glucose
B. maltose and glycogen
C. glycerol and fatty acids
D. amino acids and proteins

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32. Blood leaving the capillaries surrounding alveoli is

•**A.** oxygenated in both the left and right lung
B. deoxygenated in both the left and right lung
C. oxygenated in the left lung and deoxygenated in the right lung
D. deoxygenated in the left lung and oxygenated in the right lung

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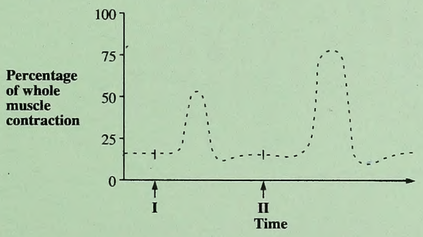
Use the following information to answer question 59.

Two electrical stimuli were applied to a **whole muscle**, the biceps. The stimulus applied at time **I** was of lower intensity than the stimulus applied at time **II**. The degree of muscle contraction was graphed.



59. A correct inference from the graph is that

A. after stimulation, a rest period increases the degree of whole muscle contraction
•**B.** the degree of whole muscle contraction is determined by the stimulus strength
C. unstimulated whole muscle has no degree of contraction
D. whole muscle contraction is an all-or-none response

keyed response (D) in contrast to 70% of the male population. This gender difference may correspond to differences in forming spatial and quantitative perceptions.

Question 15 required students to understand the difference between ingested forms of nutrients (macromolecules) and the corresponding components (micromolecules) that result from digestion of these macromolecules. Students also had to understand the difference between the contents of the alimentary canal (digestive tract) and what is formed in an accessory organ (liver). Each of the incorrect alternatives (B, C, D) was selected by about 15% of the students. Each of these answers began with a product of digestion (micromolecule) rather than with a form of nutrient that is common in the human diet. Too many of the high achievers chose alternative B. The most common ingested carbohydrates are starch, lactose, and sucrose. Maltose is a product of starch digestion and glycogen is formed in accessory structures. The reverse order of these two substances could have been a plausible answer. Likewise, the reverse order of alternative D would have been a correct answer. Perhaps some students misinterpreted the time (independent) variable of the graph and therefore reversed the order of events.

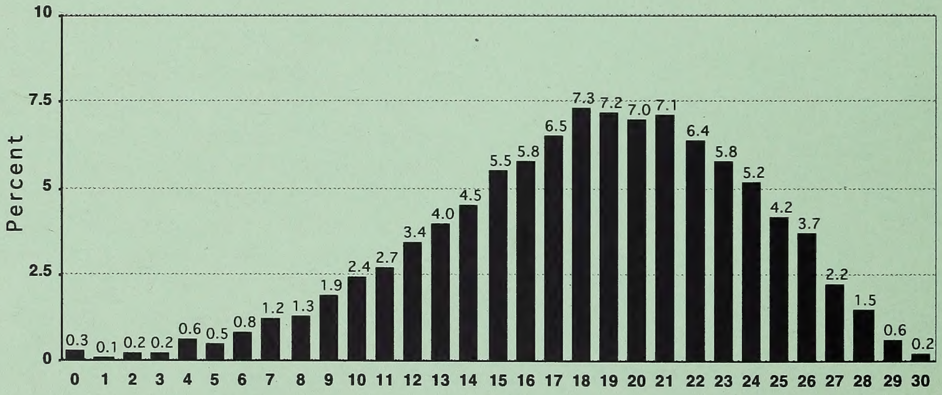
Question 32 required students to understand that blood which leaves capillaries in either lung enters the pulmonary veins and is therefore delivered to the left side of the heart. Oxygen diffuses into this blood as it passes by the alveoli. About 18% of the population thought that the two lungs are analogous to the right and left sides of the heart in that they contain either deoxygenated or oxygenated blood. These students did not understand that the pulmonary artery branches into both lungs and the pulmonary veins arise from both lungs. They chose either alternative C (11%) or alternative D (7%). About 18% of the total population, including 10% of the high achievers, chose alternative B. Perhaps these students could not visualize the relationships of the structures identified in the question. About 59% of the female population chose the keyed response in comparison to 72% of the male population.

Question 59 required students to analyze a graph for whole muscle contraction that had a superficial resemblance to a graph for neuron action potential. Many students (about 21%) chose alternative D which stated a principle that applies to individual neurons or muscle fibres but not to whole muscles. The data presented by the graph clearly contradicts the all-or-none principle in that the first response is about 53% of whole muscle contraction and the second is about 78%. This suggests that many students did not understand the difference between a whole muscle and the individual muscle fibres of which it is composed.

Some students (about 13%) missed the significance of the difference in strength between stimulus I and stimulus II. These students chose an alternative (A) that common experience would suggest is plausible; that is, a rest break will increase performance. A few students (about 4%) chose an alternative (C) that was logical but not supported by the data. Perhaps they incorrectly assumed that the line on the graph, which represented percentage of contraction, started at 0%.

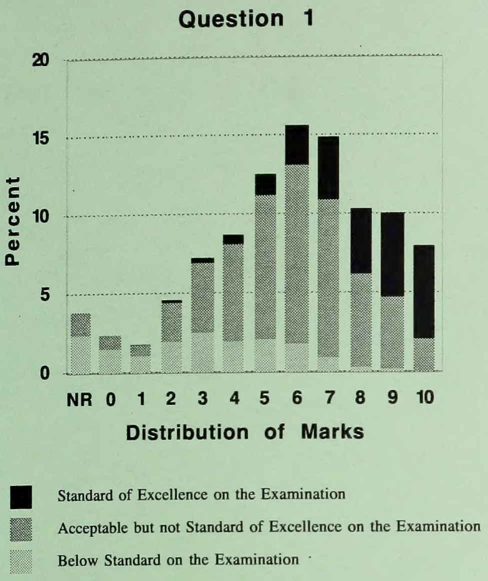
Teacher-Scored Section (Written-Response Questions)

The four questions in the written-response section provided students with a variety of assessment opportunities. Question 1 required students to explain how cystic fibrosis affects several body functions. Students were free to select the body functions and the corresponding treatment technologies. In Question 2, students were expected to draw on their understanding of process skills as developed throughout the Biology 30 course. Questions 1 and 2 grew out of contexts that are of current scientific and public interest to Albertans. Question 3 was more restrictive in that it required students to demonstrate their understanding of one specific physiological problem (high blood pressure) set in the context of a new treatment procedure. Question 4 was very specific in that it required a detailed understanding of the function of one human body structure (nephron).



Distribution of Marks for Written Response

Student responses to the teacher-scored section indicated that most students approached the examination seriously. All four questions were attempted by 91.6% of the students and very few (0.2%) did not attempt any of the four questions. A few students (0.2%) achieved full marks on each of the four questions. Approximately 76.0% of the students obtained 15 marks or more out of 30 on the teacher-scored section and 17.5% of the students obtained 24 marks or more. Most students presented answers that indicated they understood the problems to be addressed. Many students demonstrated creative and logical thought. This was particularly evident in student responses to Question 1. A review of the distribution of scores on each written response question revealed no significant gender differences.

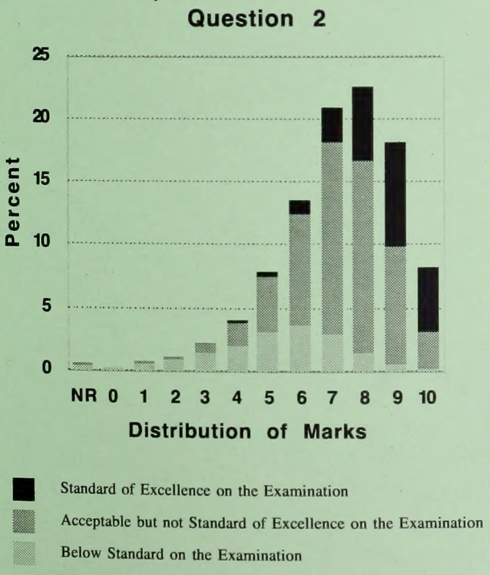


Question 1: A good proportion (71.4%) of the students addressed the major points of this question and therefore obtained 5 or more marks out of 10. Excellent answers (8 to 10 marks) were presented by 28.6% of the population. Most students made meaningful connections between the accumulation of mucus and the functions of the respiratory system. They understood how excessive mucus would not only impede the mechanics of breathing but also the transfer of gases between lung alveoli and blood. Most students understood the connections between excessive mucus and emulsification of fats. They described how blockage of the bile duct would reduce the availability of bile. Many students, however, confused the functions of exocrine and endocrine glands and therefore focused on hormone deficiencies, e.g., insulin. Some students lost marks because they did not develop cause and effect relationships fully enough to show they understood the implications of the disease.

Most students described technologies that could alleviate some of the symptoms of cystic fibrosis. Some described creative solutions to physiological problems even though they could not name the equipment or procedure described. The technologies selected usually matched the problems that were described. Therefore, if an incorrect problem was selected (hormone deficiency), the technology described was also inappropriate, e.g., insulin injections, dialysis.

Most students answered in paragraph form and used sentences that were well constructed. The correct use and spelling of biological terms was a problem for some students, e.g., psychology versus physiology.

On this 10-mark question, the average mark was 5.81 or 58%.



Question 2: Most students demonstrated a very good understanding of experimental variables. They could distinguish between the manipulated and fixed (controlled) conditions that were integral to the Cold Buster research project (parts a, b, and d). Most students could read and interpret the data. They could suggest alternative treatments because they understood the basic components of experimental design (part c). For part e many students presented the data of study 1 or 2 in a new form (interpretation). They did not state a logical and final summation that was supported by the data (conclusion); e.g., *"The first subject in Study 2 was given placebo food with no nutritional value. This subject seemed to have a higher body temp than those given food with a special nutrient mixture."* Some students presented conclusions that were not supported by or even related to the study. Part f was answered poorly by many students. They did not provide plausible physiological connections between the treatments and the responses described in the study. Too many students mistook "physiological" to mean "psychological." Student responses to part g revealed that many students do not understand

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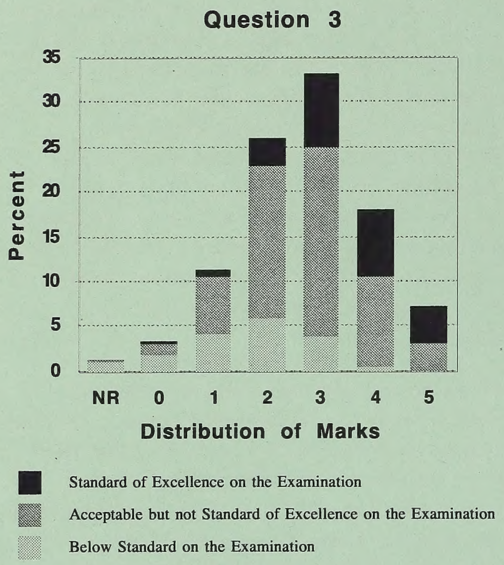

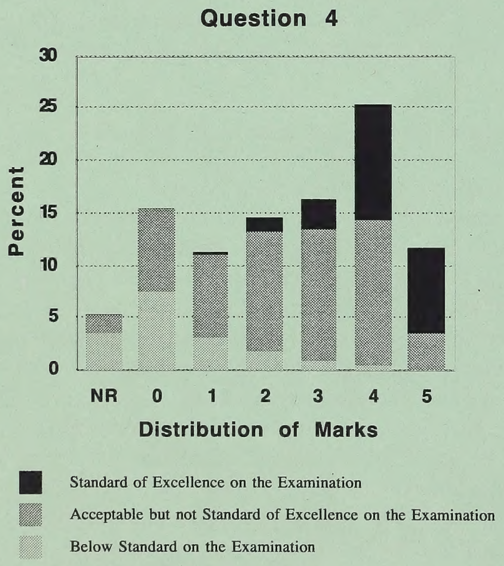

the unique environmental conditions under which the Canadian Armed Forces train or serve. They also did not understand the unique advantages of the Canadian Cold Buster^{TM} in comparison to other condensed forms of food.

On this 10-mark question the average mark was 7.19 or 72%.

Question 3: Part a of this question was well answered by most students. About 95% of the students identified at least one cause of hypertension and about 84% identified two causes. Most students understood the relationships between blood pressure and vessel size and vessel elasticity. Many also understood that a diet rich in salt or cholesterol can contribute to hypertension. Some students confused arteries and veins. Others did not distinguish between normal temporary increases and unhealthy chronic conditions. Part b was well answered by less than 25% of the students. Most students did not understand how pressure applied to the surface of the medulla could cause changes in systemic blood vessel size or in cardiac output. They did not understand the homeostatic control mechanisms for blood pressure control well enough to apply the concepts to a novel situation. Many students answered part c correctly. They recognized the validity of scientific research but also its reliability requirements.

On this 5-mark question, the average mark was 2.71 or 54%.

Question 4: About 37% of the students gave excellent answers to this question. They had a clear understanding of the primary processes of the nephron, e.g., filtration, reabsorption, and secretion. About 47% of the student population gave unacceptable answers to this question. Even though most of these students could identify substances that met the criteria described in parts a and b, they could not support their choices with good explanations. Their answers were lacking in specific details and clarity. Some students did not recognize the labelled structures that the questions referred to and therefore chose an inappropriate component; e.g., confused proximal tubule with the loop of Henle. Others did not describe the direction of movement adequately, e.g., absorption instead of reabsorption. Most students did not understand the concept of tubular secretion and therefore could not answer part c correctly.

On this 5-mark question, the average mark was 2.49 or 50%.

For further information, contact Lowell Hackman or Phill Campbell at the Student Evaluation Branch, 427-0010.